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Appendices

Appendix A. Description of the 2007 Inventory Process and Definitions.

Street Trees are defined as trees that are located within the public right-of-way or the layout of a public road. The State of Indiana grants to the local municipalities the authority for street and public shade trees within their own geographical areas.

The City of Bloomington Unified Development Ordinance defines '**Street Trees**' as "trees lying on the real estate owned or controlled by the City, excluding the real estate owned or controlled as a public park except for an area fifteen (15) feet in depth from the pavement edge on either side of any paved through streets within the park."

Inventory crew volunteers used the following guidelines below to determine whether a particular tree should be counted as a street tree.
1. The tree is located between the curb and the sidewalk.
2. The tree is located within the sidewalk corridor.
3. On streets that do not have sidewalks, the tree is located within _____ feet of a curb or pavement edge.
4. The tree is located on a traffic island or median strip.

If the tree is not located as described above, it is not considered a street tree. The following are generally **not** street trees:
- a tree located between the sidewalk and a house or building
- a tree located on the front yard of a property
- **Unless** it is within _____ feet of a road without a sidewalk, where there is a specific defined distance for an allowable public tree setback planting
- a tree that arches over the street
- **Unless** it is actually planted in one of the four types of locations described on the previous list (1-4)

Field Techniques/Data Collection

This section describes each data field that is included in the Bloomington i-Tree databases and how the data in each field was created. For categorical data fields, the i-Tree suite uses numeric categories for different values of tree condition or maintenance recommendations. Definitions for those categories are the defaults provided by i-Tree and are located here. However it is possible to change those definitions in future iterations of the inventory if the default values are not useful for the City Forester.

ID:

ID is the data base record number, and is created in each database as records are entered. This number may not always be unique to a specific tree or tree location. New databases that are created to do analyses on subsets of data, such as a particular zone, will be renumbered. The ID number is for the software only; it contains no information about a particular tree or planting space and may be ignored.

Location:

Location can be defined as any geographical area of interest that might want to be analyzed individually. For the Bloomington Inventory, we chose to define Location as established residential neighborhoods that are registered with the City. For areas not included in a neighborhood, the entry will denote non-neighborhood.

TreeID:
Tree ID is the unique number that corresponds to each data record. This number should really be thought more of as a tree site number. Over time many different trees or no trees may end up occupying a particular site. It is useful for the City Forester to maintain information about each planting site such as utility conflicts and the width of the tree lawn in order to make appropriate decisions about what tree should be planted in the future.

Zone:
Zones are defined in the i-Tree users manual to be particular management areas. Due to its relatively small size, Bloomington does not need separate management areas. We have chosen to use City Council districts for the Zone category. This will allow analysis to be performed on each individual district and will allow Council Members to better understand the how the condition of Bloomington's Urban Forest affects their district.

SpeciesCode:
Species Code is the code defined for each tree species in the i-Tree users manual Appendix D. Some tree species may not be found in the Midwest species list. Additional Species Codes may be found in other region's lists, often in the Piedmont list. Due to the limited number of species codes that are provided in the i-Tree users manual, it was occasionally necessary to group some less common varieties at the genus level. Empty tree spaces are coded as Planting Site Small (PSS, where Lawn Width is 4-6'), Planting Site Medium (PSM, where Lawn Width is 6-8'), and Planting Site Large (PSL, where Lawn Width is greater than 8').

CityTree:
City Tree denotes whether a tree is Street or Park Tree, coded as 1 or 2 respectively. As this inventory is of exclusively Street trees, all entries should be 1.

DBH:
The urban forestry tree measurement standard for size is the trunk diameter, measured at breast height. This measurement is usually abbreviated as DBH (all capital letters). Breast height is defined as 4.5 feet (4.5') above ground level. DBH will be estimated to a 2" class (2"=1.0-2.9", 4"= 3.0-4.9", etc.) with a Biltmore cruiser stick.

NOTE: The height at which the diameter is measure may have to be adjusted if an odd growth or interrupting object interferes with measuring at the 4.5' height. A tree that has a large root flare should be measured as any other tree. If the root flare extends as high as 4.5', then the diameter should be measured above it. The height at which the DBH is actually taken should then be entered in the Comments column.

LandUseCode:
Land use code describes the type of property that a tree is associated with. Options include: **1** = single family residential, **2** = multi-family residential, **3** = Industrial/Large Commercial, **4** = Park/Vacant/Other, **5** = Small Commercial.
Land use codes are used by STRATUM in the estimation of energy savings caused by trees by assuming a building type that is associated with a particular land use designation. Land use codes are also used by STRATUM in the estimation of the effect on property values that STRATUM causes.

LocationCode:
Location code denotes in what type of site the tree is growing. Definitions are as follows: **1** = Yard – In the case that a tree is located where the Public Right of Way extends into a private yard without a sidewalk, **2** = Planting Strip – Where a tree is located in a strip of unpaved ground between the roadway and sidewalk, **3** = Side walk or hard-scape cutout – Where a tree is located

in a cutout opening in a continuous stretch of concrete, occasionally surrounded by a grate, **4** = Street median – Where a tree is located in a grassy area dividing a roadway, **5** = Other maintained locations, **6** = Other un-maintained locations, **7** = Backyard – Where a tree is located along the rear of a property, such as an alleyway.

Location codes are used by STRATUM in the estimation of energy benefits by assuming an average distance between a tree in each type of location to a building associated with that property.

Maint_Rec:

Maintenance recommendation is a numeric code to describe the recommended maintenance for the tree. Definitions are as follows: **1** = **None** – Tree does not need immediate or routine maintenance, **2** = **Small tree (routine)** – Tree is in need of maintenance and of a size that a maintenance task may be performed from the ground; health or longevity of tree is not compromised by deferring maintenance for up to five years, **3** = **Small tree (immediate)** – Tree is in need of maintenance and of a size that a maintenance task may be performed from the ground; deferring maintenance beyond one year would compromise health or longevity of tree, **4** = **Large tree (routine)** – Tree is in need of maintenance and of a size that a maintenance task requires the use of large equipment such as a cherry picker; health or longevity of tree is not compromised by deferring maintenance for up to five years, **5** = **Large tree (immediate)** – Tree is in need of maintenance and of a size that a maintenance task requires the use of large equipment such as a cherry picker; deferring maintenance beyond one year would compromise health or longevity of tree, **6** = **Critical concern (public safety)** – Tree should be inspected without delay.

Maint_Task:

Maintenance Task uses a numeric code that describes the highest priority task to perform on the tree. Definitions are as follows: **1** = **None** – Tree does not need maintenance, **2** = **Stake/train** – Staking or training needed to encourage a straight trunk, strong scaffold branching, or eliminate multiple leaders, crossing branches, and girdling ties, includes removing or replacing stakes and ties to prevent damage to tree bole. **3** = **Clean** – Crown needs cleaning to remove dead, diseased, damaged, poorly attached, or crossing branches to increase health or longevity of tree, **4** = **Raise** – Crown should be raised by removing lower branches from the tree trunk to eliminate obstructions or clearance issues, **5** = **Reduce** – Crown should be reduced/thinned by pruning to reduce tree height, spread, overcrowding, wind resistance, or an increase of light penetration, **6** = **Remove** – Tree is dangerous, dead or dying, and no amount of maintenance will increase longevity or safety, **7** = **Plant** – Empty tree space should be planted with a new tree.

SidewalkDamage

Sidewalk damage is rated as being either none, low, medium, or high. Definitions from the i-Tree users Manual are as follows: **1** = **None** – Sidewalk heaved less than ¾ inch, requiring no remediation, **2** = **Low** – Sidewalk heaved ¾ to 1½ inches, requiring minor grinding or ramping, **3** = **Medium** – Sidewalk heaved 1½ to 3 inches, requiring grinding or ramping and/or replacement, **4** = **High** – Sidewalk heaved more than 3 inches, requiring complete removal and replacement.

WireConflict

A numeric code to describe utility lines that interfere with or are present above a tree. Definitions are as follows: **1** = **No lines** – No utility lines within vicinity of tree crown, **2** = **Present and not conflicting** – Utility lines occur within vicinity of tree crown, and crown is not likely to intersect utility lines in the next 3 years, **3** = **Present and conflicting** –

Utility lines occur and currently intersect with tree crown or will likely intersect within the next 3 years.

ConditionWood / ConditionLeaves

Each tree assigned to a category –Good, Fair, Poor or Dead. While there is some debate about the importance of collecting separate information about the condition of the wood of a tree and the condition of its leaves, we have chosen to rate the overall tree condition. This is partially due to the fact that much of the data was collected during the winter when leaf condition was not observable. In keeping with the i-Tree Users Manual, both fields will be rated the same for the single measurement when measuring overall tree condition. Definitions are as follows: **4 = Good (G) -** Full canopy, Minimal to no mechanical damage to trunk, No dieback of branches over 2" diameter, No suckering (root or water sprouts), Form is characteristic of species. **3 = Fair (F) -** Thinning canopy, New growth medium to low amount, or stunted, Significant mechanical damage to trunk, new or old, Insect/disease that is affecting tree, Form not representative of species, Premature fall coloring on foliage, Needs train pruning. **2 = Poor (P) -** Tree is declining, Visible dead branches over 2" diameter in canopy, Significant dieback of other branches, Severe mechanical damage to trunk, usually including decay from damage, New foliage small, stunted, or minimal amount, Needs priority pruning. **1 = Dead (D) -** No signs of life with new foliage, Bark may be beginning to peel, Default value for empty planting sites.

Other 1

In the Other 1 field, we have chosen to collect data on the "Lawn Width" for a planting site. i-Tree limits the number of categories of data for each field to ten, thus categories 1-9 correspond to lawn widths of 2-10 ft respectively and category 10 corresponds to a lawn that is greater than 10 ft wide; i.e. 1 = 2', 2 = 3', 3 = 4', 4 = 5', 5 = 6', 6 = 7', 7 = 8', 8 = 9', 9 = 10', and 10 = >10'

Other 2

Other 2 is used to identify "Tree Location", on what side of a property each tree is located, with respect to the side that corresponds to the street address of the property. Options are: **1 = Front, 2 = Right Side, 3 = Left Side, 4 = Rear.**

Other 3

Other 3 is used for "Location Order", to distinguish each tree or planting site from others on the same side of the property. Numbering begins at 1 on each property and increases in the direction of increasing address numbers.

StreetName

The name of the street of the property that a tree is associated with is on.

StreetNumber

The address number of the property a tree is associated with.

SurveyorID

The name of the surveyor taking the data.

SurveyDate

The date the data was collected.

Data Transformations to STRATUM format.

Data collection for the 2007 inventory began before consulting the protocols of the i-Tree program suite and the manner in which data was collected prior to 3/07 utilized the methods and definitions of previous Bloomington Street Tree Inventories. Thus some manipulation of the data was needed to conform to the STRATUM format. Three data fields are subject to these changes.

Maintenance

First the Maintenance Recommendation and the Maintenance Task fields give a finer level of detail than the previous method of recording maintenance needs did. Previously the options available included Routine Small and Routine Large for trees that did not pose any hazard and were in good health. There was no option for trees that did not require any maintenance. Three levels of Priority Pruning were available with level 3 as the lowest priority and 1 as the highest priority. Levels were based on the relative level of threat each tree posed, based on size of the tree and diameter of dead branches. A category of Train would be applied to young trees that needed training supports or pruning. Lastly trees could be slated for Removal.

Since there was no other way to define trees that did not require maintenance, the Routine Small and Large categories were the default value for these trees, while Priority ratings were given to trees that did require some sort of attention. Thus all trees rated as Routine Small and Large will be given the category of None for both the Maintenance Recommendation and Task.

Trees that were given a Priority rating previously will be given either the Young or Mature Tree Immediate rating with young trees defined as those whose maintenance needs could be accomplished by personnel on the ground. The vast majority of these priority rankings were based on dead branches in the crown, and a Maintenance Task of Clean will be given to those records unless a more appropriate task can be discerned from the field notes.

Trees that required training will be given a Young Tree Immediate Recommendation and Stake/Train as the task.

Trees coded for removal will be given either a Mature Tree Immediate or Critical Concern based on whether the reason for removal was due to being an undesirable species or a safety threat respectively. The task will remain Removal.

Utility Wire

Previous inventories only coded for the presence or absence of utility wires. With the new classification scheme we can differentiate between wires that are conflicting with a tree that may need to be pruned and wires that are present and might potentially conflict with a tree in the future. Since all we know for each of these entries is whether or not a wire is present, all wires will be classified as present but not conflicting. This represents the same level of information as was available in the old system, but avoids calling for pruning on trees that may not need it.

New Fields

New Fields such as Land Use, Location Code, and Sidewalk Damage will be given zero values as there is no record of any kind for those fields. These fields will be updated in future iterations of the inventory.
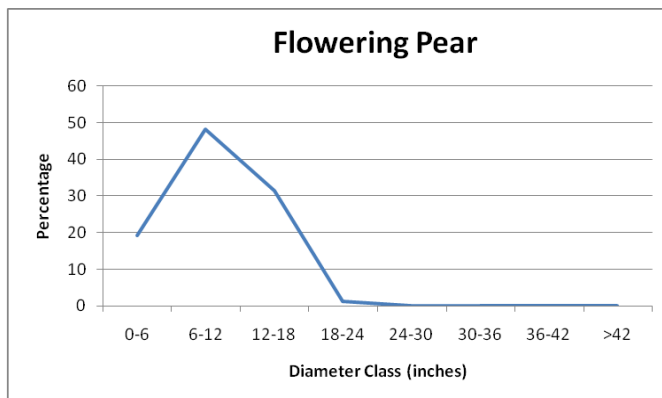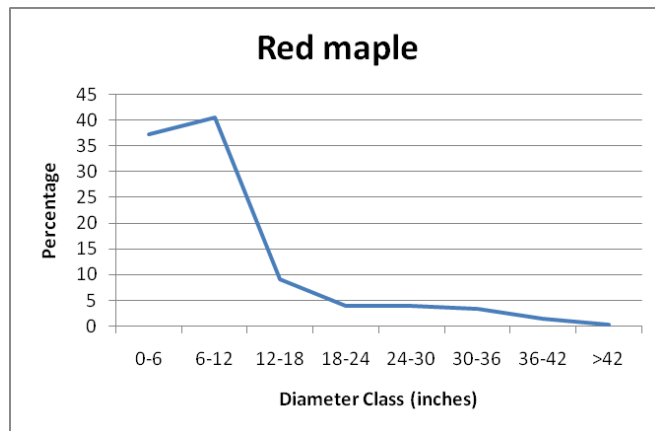
Appendix B. Population Summary for the 2007 Bloomington Street Tree Inventory.

Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total
Red maple *Acer rubrum*	453	314	832	186	81	81	70	28	6	2051
Flowering pear *Pyrus species*	101	136	598	390	15	1	1	0	0	1242
Sugar maple Acer saccharum	42	66	311	174	159	157	73	17	4	1003
Pin oak Quercus *palustris*	145	130	181	253	65	33	22	4	1	832
Silver maple Acer *saccharinum*	45	15	55	101	110	151	119	85	61	742
Crabapple Malus species	47	70	378	66	4	1	0	0	0	566
Green ash *Fraxinus pennsylvanica*	36	85	206	142	30	5	4	0	4	512
Sweetgum *Liquidambar styraciflua*	67	49	128	104	40	11	1	0	0	400
White ash *Fraxinus americana*	75	70	175	28	4	4	7	2	3	368
Eastern redbud *Cercis canadensis*	49	66	163	32	2	0	0	0	0	312
Northern red oak *Quercus rubra*	57	87	107	14	4	0	1	1	0	271
Flowering Dogwood *Cornus florida*	36	64	145	7	1	0	0	0	0	253
Ginkgo *Ginkgo biloba*	73	54	105	4	3	1	0	0	0	240
Littleleaf linden *Tilia cordata*	12	35	145	36	7	0	1	0	0	226
Basswood species *Tilia species*	26	10	76	81	18	12	1	0	0	224
Eastern white pine *Pinus strobus*	4	2	75	82	21	3	3	0	0	190
Norway maple *Acer platanoides*	44	24	59	25	7	3	0	0	1	163
Tulip tree *Liriodendron tulipifer*	5	6	23	38	49	19	11	5	2	158
Pine species *Pinus species*	8	6	54	36	21	9	4	1	0	139
Spruce species *Picea species*	7	15	62	35	2	0	0	0	0	121
White oak *Quercus alba*	97	4	7	6	1	0	0	0	2	117
Honeylocust *Gleditsia triacanthos*	1	20	40	30	8	9	2	0	0	110
Black walnut *Juglans nigra*	3	1	17	20	24	20	7	2	0	94
Eastern red cedar *Juniperus virginiana*	2	7	56	18	4	1	0	0	0	88
Northern hackberry *Celtis occidentalis*	2	1	13	14	25	12	4	9	4	84
Hawthorn *Crataegus species*	8	31	40	1	1	0	0	0	0	81
American Elm *Ulmus americana*	25	9	25	8	4	1	3	4	1	80
Blue spruce *Picea pungens*	27	4	23	18	2	1	0	0	0	75
Japanese Zelkova *Zelkova serrata*	9	16	43	6	0	0	0	0	0	74
Arborvitae *Thuja species*	6	39	22	1	1	0	0	0	0	69
Elm species *Ulmus species*	7	0	21	18	8	6	3	1	3	67
Oak species *Quercus species*	27	7	16	5	8	2	0	0	0	65
Eastern hemlock *Tsuga canadensis*	7	21	17	9	4	0	0	0	0	58
Ash species *Fraxinus species*	3	3	11	22	11	2	3	1	1	57

Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total
American sycamore *Platanus occidentalis*	0	0	3	14	11	13	4	6	5	56
Fir species *Abies species*	0	5	38	8	3	2	0	0	0	56
Black spruce *Picea mariana*	15	4	17	17	2	0	0	0	0	55
Black cherry *Prunus serotina*	3	1	13	25	5	3	3	0	1	54
Norway spruce *Picea abies*	1	3	16	17	8	2	2	0	0	49
Apple *Malus species*	1	4	22	9	3	0	0	0	0	39
Siberian elm *Ulmus pumila*	1	0	5	14	8	5	2	1	1	37
White mulberry *Morus alba*	4	1	17	8	4	3	0	0	0	37
Maple species *Acer species*	0	5	17	8	2	0	0	1	0	33
Plum *Prunus species*	2	5	13	6	5	1	1	0	0	33
Boxelder *Acer negundo*	0	0	6	10	6	7	2	0	0	31
American basswood *Tilia americana*	4	8	9	5	1	0	1	2	0	30
River birch *Betula nigra*	2	3	12	12	0	0	0	0	0	29
Black locust *Robinia pseudoacacia*	1	2	10	6	6	1	0	1	0	27
Chinkapin oak *Quercus muehlenbergii*	0	0	19	1	1	1	0	0	0	22
Mulberry species *Morus species*	0	1	6	7	2	5	1	0	0	22
Southern Magnolia *Magnolia grandiflora*	0	11	5	4	1	0	0	0	0	21
Japanese maple *Acer palmatum*	6	4	9	1	0	0	0	0	0	20
Scotch pine *Pinus sylvestris*	0	0	9	11	0	0	0	0	0	20
Birch species *Betula*	3	5	5	2	0	1	0	0	0	16
Serviceberry *Amelanchier arborea*	0	7	8	1	0	0	0	0	0	16
Shagbark hickory *Carya ovata*	0	0	6	5	1	1	0	1	0	14
Scarlet oak *Quercus coccinea*	3	7	4	0	0	0	0	0	0	14
English oak *Quercus robur*	0	0	11	2	0	0	0	0	0	13
Willow species *Salix*	1	2	3	3	1	2	0	0	0	12
Red pine *Pinus resinosa*	1	1	5	3	1	1	0	0	0	12
Kentucky coffeetree *Gymnocladus dioicus*	5	1	5	0	0	0	0	0	0	11
European hornbeam *Carpinus betulus*	3	1	4	3	0	0	0	0	0	11
Swamp white oak *Quercus bicolor*	2	1	8	0	0	0	0	0	0	11
Catalpa species *Catalpa species*	0	2	0	6	2	0	0	0	0	10
Tree of Heaven *Ailanthus altissima*	0	0	0	2	1	1	2	3	0	9
Cottonwood *Populus deltoides*	0	1	0	6	0	0	1	1	0	9
Sweetbay *Magnolia virginiana*	1	2	3	2	0	1	0	0	0	9
Beech species *Fagus species*	1	0	0	3	1	3	0	0	0	8
Sawtooth oak *Quercus acutissima*	3	0	5	0	0	0	0	0	0	8
Kwanzan cherry *Quercus*	2	1	3	2	0	0	0	0	0	8

Species	0-3	3-6	6-12	12-18	18-24	24-30	30-36	36-42	>42	Total
acutissima										
Hickory species *Carya species*	0	0	1	2	3	0	0	0	0	6
Paper birch *Betula papyrifera*	0	2	2	1	0	0	0	0	0	5
American Beech *Fagus grandifolia*	0	0	0	1	3	1	0	0	0	5
Persimmon *Diospyros virginiana*	0	0	1	4	0	0	0	0	0	5
Cherry plum *Prunus cerasifera*	2	0	3	0	0	0	0	0	0	5
Blackgum *Nyssa sylvatica*	0	0	1	2	1	0	0	0	0	4
Chinese chestnut *Castanea mollissima*	0	0	1	1	0	1	1	0	0	4
Eastern hophornbeam *Carpinus caroliniana*	0	0	2	2	0	0	0	0	0	4
European Beech *Fagus sylvatica*	0	0	2	1	0	0	0	0	0	3
Dawn Redwood *Metasequoia glyptostroboides*	0	0	0	1	0	2	0	0	0	3
Willow oak *Quercus phellos*	1	0	0	2	0	0	0	0	0	3
Mimosa *Albizia julibrissin*	2	1	0	0	0	0	0	0	0	3
Goldenrain Tree *Koelreuteria paniculata*	0	0	2	1	0	0	0	0	0	3
Holly *Ilex opaca*	0	1	2	0	0	0	0	0	0	3
Austrian pine *Pinus nigra*	0	1	2	0	0	0	0	0	0	3
Shumard oak *Quercus schumardii*	0	2	0	0	0	0	0	0	0	2
American hornbeam *Carpinus caroliniana*	2	0	0	0	0	0	0	0	0	2
Osage Orange *Maclura pomifera*	0	0	0	1	0	1	0	0	0	2
Bitternut hickory *Carya cordiformis*	0	0	1	0	0	0	0	0	0	1
Mockernut hickory *Carya tomentosa*	0	0	0	1	0	0	0	0	0	1
Black poplar *Populus nigra*	0	1	0	0	0	0	0	0	0	1
Swamp Chestnut oak *Quercus michauxii*	0	0	0	0	1	0	0	0	0	1
Baldcypress *Taxodium distichum*	0	0	0	0	0	1	0	0	0	1
Amur corktree *Phellodendron amurense*	0	0	0	0	0	1	0	0	0	1
Sassafras *Sassafras albidum*	0	0	1	0	0	0	0	0	0	1
Autumn Olive *Elaeagnus umbellata*	0	0	1	0	0	0	0	0	0	1
Witch Hazel *Hamamelis species*	0	0	1	0	0	0	0	0	0	1
Japanese lilac tree *Syringa reticulata*	0	0	1	0	0	0	0	0	0	1
Unknown species	19	5	16	5	1	0	1	0	0	47
Other Small Conifer	4	10	2	0	0	0	0	0	0	16
Other small broad	8	4	0	0	0	0	0	0	0	12
Other large Broad	1	0	0	2	0	0	0	1	0	5
Other medium broad	0	0	3	1	0	0	0	0	0	4
Other medium Conifer	0	3	5	3	1	0	0	0	0	12
Other large Conifer	0	0	1	0	0	0	0	0	0	1
Other pine species	0	0	0	1	0	0	0	0	0	1
Grand Total	1661	1575	4597	2266	827	605	361	177	100	12169

Appendix C. Top Five Species Diameter (DBH) Class Distributions

Red maple

Flowering Pear

Sugar maple

Percentage vs Diameter Class (inches)

Silver Maple

Percentage vs Diameter Class (inches)

Pin oak

Percentage vs Diameter Class (inches)